



ATOP-R&D

Human Factors Newsletter # 05-24

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Articles in this newsletter:

- *Subjective Workload Ratings and Eye Movement Activity Measures*
- *Simulator/Flight Training Evaluation*
- *New FAA Researcher*
- *En Route Information Display System (ERIDS) Study*
- *Traffic Flow Management User Tea Support*
- *National Traffic Management Log (NTML)*
- *Calendar*

Technical Note: Ahlstrom, U., & Friedman-Berg, F. (2005). *Subjective Workload Ratings and Eye Movement Activity Measures* (DOT/FAA/CT-05/32). Atlantic City International Airport, NJ: FAA William Hughes Technical Center

Abstract: Air traffic controllers respond to system demands generated by sector traffic, communications, and the overall air traffic control (ATC) environment. As the system's task load increases, there can be an increased demand on controller performance resulting in increased controller workload. Because workload levels can affect controller performance, researchers have spent a great deal of effort developing reliable measures of controller workload. One common measurement technique is to use self-reported workload ratings generated by controllers as they perform ATC tasks. Although these methods have proven to generate reliable workload estimates, there is a limit to their applicability in capturing real-time changes in workload levels. Therefore, as a supplement to subjective workload ratings, researchers have explored the use of eye movement parameters that are correlated with cognitive demands. The most commonly used metrics are blink rate and duration, pupil diameter, saccadic extent, fixation frequency, and dwell time. By using real-time eye movement measures to evaluate workload, we could potentially detect changes in workload and identify what the controller was looking at when these changes occur.

In the present study, we explored the relationship between subjective workload ratings and eye activity measures from a high-fidelity human-in-the-loop weather simulation (Ahlstrom & Friedman-Berg, 2005). First, we assessed the relationship between subjective workload ratings

and the task load variable, aircraft density. We found that workload ratings increased linearly with an increasing number of aircraft. Second, we assessed how eye activity measures of saccades, blinks, and pupil diameter correlated with aircraft density. We found that the mean blink duration and the mean saccade distance decreased as a function of an increased number of aircraft, while the mean pupil diameter increased as a function of an increased number of aircraft. Third, we explored the possibility of using this eye data to predict the minute-by-minute number of aircraft in the sector by means of multiple regression and neural network models. Using regression modeling, we were able to produce individual controller models (R ranging from .19 to .89) and a general model ($R = .58$) with good mean prediction performances. Using neural network models, we produced individual controller models ($r = .26$ to $r = .92$) and a general model ($r = .84$) with even greater mean prediction performances.

These results indicate the possibility of using real-time workload estimates derived from eye movement activity measures for the development and evaluation of ATC systems. For instance, we might use eye movement metrics to implement ATC systems that incorporate adaptive automation. The purpose of adaptive automation is to automate certain tasks when workload increases past a certain level, returning these tasks to the operator as workload decreases. Other potential operational uses are the development of workload watch systems to determine when to adjust staffing, when to divide sectors, or how to distribute tasks among controller teams. Real-time metrics would also be useful when developing new ATC procedures and ATC tool interfaces. The use of real-time workload measures would be particularly useful for the evaluation of displays or procedures in instances when the evaluation of controller performance does not detect any differences.

This research activity supports the Administrator's Flight Plan Goal for Greater Capacity, Objective 3: Increase on-time performance of scheduled carriers

Points of Contact: U.Ahlstrom, F. Friedman-Berg, WJHTC

Simulator/Flight Training Evaluation: During the period November 28, 2005 – December 14, 2005, Dennis Beringer served as the human factors advisor to a Flight Standardization Board examination of issues related to the Mitsubishi MU-2 aircraft. The review included in-the-field evaluations at Orlando, FL and Addison, TX. Cockpit human factors assessments and task loading assessments were conducted in both flight training devices and the aircraft. Findings were reported to the Board at the conclusion of the evaluations. *This research activity supports the Administrator's Flight Plan Goal for Safety, Objective 2: Reduce the number of fatal accidents in general aviation.* (D. Beringer, CAMI)

New FAA Researcher: Tom Chidester joined CAMI's human factors team on December 12, 2005 as Manager of the Human Factors Research Branch, Aerospace Human Factors Research Division. Tom previously served as Director of the Aviation Performance Measuring System program at NASA-Ames Research Center. In this capacity, he led a development team working to design advanced concepts and software for analysis of aircraft flight data. He also led NASA's efforts to develop hardware, software, and networking to support sharing of flight data and safety reports among the airlines and the FAA. His other experience includes Manager of Human Factors and Safety Training for American Airlines from 1990 to 2001. There he led re-development of classroom human factors programs for pilots and flight attendants, and assisted

in development of Line Oriented Flight Training on all American's aircraft fleets. Tom also accomplished analysis, publication, and reporting for ASAP, then a cooperative, experimental Aviation Safety Action Program developed by American, the Allied Pilots Association, and the FAA. From 1996 to 2000, he served as chair of the Air Transport Association Subcommittee on Automation Human Factors. (D. Schroeder, CAMI)

En Route Information Display System (ERIDS) Study: Researchers from the William J. Hughes Technical Center's Human Factors Group are conducting a study to evaluate the benefits of ERIDS compared to the current paper reference manuals system. The team visited Houston Air Route Traffic Control Center and observed controllers during live operations to determine how often controllers used paper reference materials. The researchers also collected data in a simulation activity with 20 supervisors to determine how quickly information is accessed using paper reference manuals. The results will be compared to data collected at the Jacksonville Air Route Traffic Control Center which is currently using ERIDS. *This research activity supports the Administrator's Flight Plan Goal for Greater Capacity, Objective 3: Increase on-time performance of scheduled carriers.* (R. Sollenberger, B. Bunting, WJHTC)

Traffic Flow Management User Team Support: Engineering research psychologists from the William J. Hughes Technical Center's NAS Human Factors Group participated in the Traffic Flow Management User Team meeting held at the Volpe Center in Boston. They presented initial user interface prototypes demonstrating how high-resolution echo tops data could be added to the Traffic Situation Display (TSD). Traffic Management Coordinators (TMCs) use echo tops information to develop routes for aircraft that may be able to fly over severe weather and avoid costly reroutes. The user interface prototypes are based on earlier designs created by the Corridor Integrated Weather System program for similar data on the stand-alone display. Additional prototyping is necessary when incorporating these data onto the TSD because of the high-priority traffic and route information that also appears on the display. Human factors issues being considered include the readability of data, integration with existing information on the TSD, and the controls that TMCs would need to make the best use of the echo tops data. *This research activity supports the Administrator's Flight Plan Goal for Safety, Objective 5: Enhance the safety of FAA's air traffic systems.* (T. Yuditsky, B. Bunting, WJHTC)

National Traffic Management Log (NTML): The NTML working group met at the William J. Hughes Technical Center on December 13-15, 2005. Research Psychologists from the NAS Human Factors Group supported the meeting by providing prototyping capabilities and human factors guidance in the development of software requirements. As information, whenever possible, researchers followed an iterative development process for designing prototypes of displays that meet the operational needs of the users in the field as well as human factors design guidelines and best practices. *This research activity supports the Administrator's Flight Plan Goal for Greater Capacity, Objective 3: Increase on-time performance of scheduled carriers.* (T. Yuditsky, B. Bunting, WJHTC)

More information on human factors research can be found at the FAA Human Factors (ATOP-R&D) web site: <http://www.hf.faa.gov>

Paul Krois
FAA (ATO-P R&D Human Factors)



January 9-12, 2006 - 44th AIAA Aerospace Sciences Meeting and Exhibit, Reno Hilton, Reno, NV <http://www.aiaa.org/>

January 21-25, 2006 – ASHRAE Winter Meeting and Expo, Chicago, IL
<http://www.ashrae.org/template/AssetDetail/assetid/45794>

January 22-26, 2006 – TRB 85th Annual Meeting, Washington, DC <http://trb.org/calendar/>

January 23-27, 2005 - S-18 Safety Assessment for Airborne Systems & Equipment
San Antonio, TX, lemon@sae.org

February 9-10, 2006 - Swinburne University Symposium on Safety Management and Human Factors Symposium, Melbourne, Australia janca@groupwise.swin.edu.au
<http://www.swin.edu.au/aviation/forms/2006SwinburneSymposiumCallforPapers.pdf>

February 21-26, 2006 – Asian Aerospace 2006, Changi Exhibition Centre, Singapore
www.asianaerospace.com

February 26-28, 2006 – Heli-Expo, Dallas, TX <http://www.heliexpo.com>

February 28 – March 1, 2006 – 31st Annual FAA Aviation Forecast Conference, Wash, DC
http://www.faa.gov/news/conferences/aviation_forecast_2006/.

March 2-3, 2006 – APA Division 21 (Applied Experimental Psychology), Division 19 (Military Psychology) and the Potomac Chapter, Human Factors and Ergonomics Society Mid-Year Symposium, George Mason University, Fairfax, VA
<http://www.apa.org/divisions/div21/homepage.html>

March 12-14, 2006 – AirCargo 2006, Sheraton Bal Harbour, FL
<http://www.aircargokonference.com>

March 13-15, 2006 – Flight Safety Foundation 18th Annual European Aviation Safety Seminar, Athens, Greece <http://www.flightsafety.org/seminars.html#eass>

March 20-23, 2006 – 16th Annual AAMI/FDA International Conference on Medical Device Standards and Regulation, Hyatt Regency, Reston, VA
<http://www.aami.org/meetings/isc/index.html>

March 22 - 25, 2006 - Society for Behavioral Medicine Annual Meeting and Scientific Sessions, San Francisco, CA www.sbm.org/annualmeeting/index.html

March 23-25, 2006 - 17th Annual International Women in Aviation Conference, Opryland Hotel Nashville, TN <http://www.wai.org/>

March 23-27, 2005 – IA Summit 2006, Hyatt Regency, Vancouver, BC, Canada <http://www.iasummit.org/>

March 28-30, 2006 – Aviation Industry Expo, Las Vegas, NV <http://www.aviationindustryexpo.com>

April 4-10, 2006 – Sun ‘n Fun, Lakeland, FL <http://www.sun-n-fun.org/content/>

April 6-7, 2006 – National Human Capital Summit, Chicago Marriott Downtown, Chicago, IL http://www.humancapitalinstitute.net/conference_national.html

April 18-20, 2006 – FAA Aviation Safety Programs Conference, Grand Hyatt Hotel, Denver, CO <http://www.aviationsafetyconference.com>

April 22-27, 2006 – CHI 2006, Montreal, Quebec, Canada <http://www.chi2006.org/call/hcioverviews.php>

April 23-28, 2006 - Avionics Systems Division Meeting, New Orleans, LA (TBD) lemon@sae.org

April 24-26, 2005 – ATCA/FAA/NASA Annual Technical Symposium, Atlantic City, NJ http://www.atca.org/activities/event_items.asp?month=4&year=2006&item_id=3557

April 25-27, 2006 – Maintenance, Repair & Overhaul (MRO) Conference & Exhibition, Phoenix Civic Plaza, Phoenix, AZ <http://www.aviationnow.com/conferences/mromain.htm>

May 1-4, 2006 - 47th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference; 14th AIAA/ASME/AHS Adaptive Structures Conference; 7th AIAA Gossamer Spacecraft Forum; 2nd AIAA Multidisciplinary Design Optimization Specialist Conference; 1st AIAA Non-Deterministic Approaches Conference, Hyatt Regency Newport, Newport, RI <http://www.aiaa.org/>

May 3-5, 2006 - 6th Annual European Business Aviation Convention & Exhibition (EBACE2006), Geneva, Switzerland <http://web.nbaa.org/public/cs/amc/>

May 9-11, 2006 – Flight Safety Foundation 51st Annual Corporate Aviation Safety Seminar, Phoenix, AZ <http://www.flightsafety.org/seminars.html#eass>

May 14-18, 2006 - 77th Annual Scientific Meeting of the Aerospace Medical Association, Caribe Royale Hotel, Orlando, FL <http://www.asma.org/>

May 15-16, 2006 – DoD TAG, Las Vegas, NV <http://hfetag.dtic.mil/meetschl.html>

May 15-16, 2006 – ASTM F38 Unmanned Aircraft Systems Committee Workshop, Sheraton Centre Toronto; Toronto, ON CAN <http://www.astm.org/>

May 17-19, 2006 – 17th International Conference on Heating and Ventilation, Prague, Czech Republic <http://www.acv2006.cz>

May 22-24, 2006 - 9th IFAC Symposium on Automated Systems Based on Human Skill And Knowledge, Nancy, France <http://www.cdc.gov/niosh/exhibits.html>

May 25-28, 2006 – American Psychological Society 18th Annual Convention, New York Marriott Marquis, New York City, NY <http://www.psychologicalscience.org/convention/>

June 6-8, 2006 – IEE System Safety Conference, Savoy Place, London, UK <http://www.iee.org/events/event/CE202BA5-A0D3-8FE7-2F35A59A02C8B3F3>

June 8-10, 2006 – NTSB Bar Association Annual CLE Conference, NTSB Conference Center, L'Enfant Plaza, Wash, DC <http://www.ntsbbbar.org/>

June 11-14, 2006 – The American Society of Safety Engineers Safety 2006 Conference, Washington State Convention and Trade Center, Seattle, WA <http://www.asse.org/2006pdcallforpapers.pdf>

June 12-16, 2006 – UPA 2006 – 15th Annual Conference, Broomfield, CO http://www.usabilityprofessionals.org/conferences_and_events/upa_conference/2006/

June 24-26, 2006 – AAMI Conference & Exposition, Wash, DC <http://www.aami.org/proposals/index.html>

June 24-28, 2006 – ASHRAE Annual Conference, Quebec, Canada <http://www.ashrae.org/>

June 26-29, 2006 - [General Aviation Technology Conference](#) , Hyatt Hotel, Wichita, Kansas,

July, 2006 - 26th International Congress of Applied Psychology, Athens, Greece dgeorgas@dp.uoa.gr , http://www.erasmus.gr/dynamic/conventions.asp?conv_id=21r/dynamic/conventions.asp?conv_id=21

July 10-14, 2006 – IEA 2006, 16th World Congress on Ergonomics, Maastricht, The Netherlands <http://www.iea2006.org/>

July 24-30, 2006 – EAA AirVenture, Oshkosh, WI <http://www.airventure.org/>

August 10-13, 2006 – American Psychological Association Annual Meeting, New Orleans, LA <http://www.apa.org/convention05/future.html>

August 21-24, 2006 - AIAA Modeling and Simulation Technologies Conference and Exhibit.
Keystone Resort and Conference Center, Keystone, CO
<http://www.aiaa.org/content.cfm?pageid=1>

August 21-24, 2006 - AIAA Guidance, Navigation, and Control Conference and Exhibit,
Keystone Resort and Conference Center, Keystone, CO
<http://www.aiaa.org/content.cfm?pageid=1>

September 6-8, 2006 - 11th AIAA/ISSMO Multidisciplinary Analysis and Optimization
Conference, Renaissance Portsmouth, Portsmouth, VA,
<http://www.aiaa.org/content.cfm?pageid=1>

September 10-14, 2006 - 54th International Congress of Aviation and Space Medicine,
Bangalore, India. A preliminary registration form may be found at <http://www.isam-india.org/conference44/newreg.php>.

September 20-22, 2006 – HCI-Aero 2006, Seattle, WA <http://www.eurisco.org/hci-aero2006>

Note: Submission Deadlines:

15th March 2006 - Full Research Papers

15 April 2006 - Industry Papers

15 April 2006 - Early Stage Research Papers

15 April 2006 - Panels, Workshops

15 April 2006 - Posters and Demos

September 26-27, 2006 – AIAA Aviation Technology, Integration and Operations Conference,
Hyatt Regency, Wichita, KS <http://www.aiaa.org/content.cfm?pageid=1>

October 15-19-2006 – Digital Avionics Systems Conference, Hilton Portland, Portland, OR
<http://www.dasconline.org/>

October 17-19, 2006 – NBAA 59th Annual Meeting and Convention, Orlando, FL
<http://web.nbaa.org/public/cs/amc/futuresites.php>

September 25-27, 2006 - 6th AIAA Aviation Technology, Integration and Operations Forum,
Hyatt Regency Wichita, Wichita, KS <http://www.aiaa.org/content.cfm?pageid=1>

October 23-25, 2006 – 44th Annual SAFE Symposium, Reno Hilton Hotel, Reno, NV
<http://www.safeassociation.org/symposium.htm>

October 23-26, 2006 - DoD Maintenance Symposium & Exhibition, Reno Hilton, Reno,
Nevada <http://www.sae.org/events/conferences/aerospace/>

October 29 - November 1, 2006 – ATCA Convention and Exposition, Marriott Wardman Park,
Wash, DC

November 9-11, 2006 – AOPA Expo 2006, Palm Springs, CA
<http://www.aopa.org/expo/2005/virtual/>

November 13-14, 2006 ASTM F38 Unmanned Aircraft Systems Committee Workshop, Hyatt Regency, Atlanta, GA <http://www.astm.org/>

January 8-11, 2007 - 45th AIAA Aerospace Sciences Meeting and Exhibit, Reno Hilton, Reno, NV <http://www.aiaa.org/content.cfm?pageid=1>

May 21-22, 2007 - ASTM F38 Unmanned Aircraft Systems Committee Workshop, Waterside Convention Center, Norfolk, VA <http://www.astm.org/>

July 22-27, 2007 – 12th HCI International, Beijing, China <http://www.hcii2007.org/>

September 25-27, 2007 - NBAA 60th Annual Meeting and Convention, Atlanta, GA
<http://web.nbaa.org/public/cs/amc/futuresites.php>

Note: Calendar events in Italics are new since the last Newsletter



Comments or questions regarding this newsletter?
Please contact Bill Berger at (334) 271-2928
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